

# Technical Guideline II

## Hydrologic Testing

This technical guideline provides the specifications for hydrologic testing to be conducted within a permit/production area. These procedures shall be complied with as closely as possible. Modification of the testing procedures must be approved in writing by the Executive Director.

Upon the completion of production zone wells and aquifer monitoring wells, the operator shall conduct a hydrologic test to determine:

1. The hydraulic properties of the production zone aquifer;
2. The degree of hydraulic connection between aquifers;
3. That the monitoring wells have been completed in the proper strata; and
4. To recognize the presence of hydraulic boundaries and recharge structures.

### **1. Test Procedure**

#### **A. Pre-Test Period**

Approximately 48-hours before the initiation of the pump test, all controllable activities which could possibly affect the aquifer such as drilling and pumping, should be stopped to allow the aquifer to return to normal. After the aquifer has stabilized, diurnal fluctuations due to tidal influence and extremes in barometric pressures should be noted and compared to the water level readings at these extremes.

#### **B. Water Level Recorders**

As many continuous water level recorders as is practicable should be installed in each aquifer subject to being influenced by the test. Charts from these recorders will be useful in determining the effect of tidal influence, barometric pressure, and precipitation during the test. This data will be submitted along with the other test results.

#### **C. Observation Wells**

1. Distribute the observation wells as uniformly as possible around the pumped well and at variable distances from the pumped well.
2. It is recommended that the operator use no less than 3 observation wells. Such factors as boundary and recharge areas, transmissivity variations, leakage, etc., may provide unreliable information even over small distances. Therefore using 8 or more observation wells will yield more accurate data.

3. Observation wells with a minimum diameter of four inches are required for automatic water level recorders. When tape measurements are made, well diameters as small as 2 inches may be suitable.
4. All wells must be open to the water bearing zone, remain open during the entire test, and penetrate the entire sand interval so that the flow toward the pumping well is horizontal and drawdown values are not affected by partial penetration.
5. Well numbers and reference points for water level measurements should be clearly marked on each well casing.

**D. Pumping Well**

1. The well should be pumped at approximately  $\frac{3}{4}$  of its probable maximum yield so that the hydraulic characteristics of the well and the aquifer can be evaluated.
2. The well must be equipped to allow a water level measuring line to be lowered into the well.
3. The water must be discharged in such a way that it cannot return to the water bearing formation.
4. A constant pumping rate is necessary. The discharge pipe should be equipped with a flowmeter and a flow control valve.
5. In the event of pump failure, recovery of water levels should be monitored.

**E. Water Level Measurements**

1. Antecedent Conditions - Water level measurements should be taken, either with continuous water level recorders or periodically with tape, in the pump well and in all observation wells 24 hours prior to the test to establish the initial static water level. Water levels should be measured to the nearest 0.01 foot. All possible outside influences such as pumpage of nearby wells, barometric changes, and changes in stream flow, should be observed, recorded, and if possible, controlled to the extent that they have little or no influence on the groundwater level during the test. If the water levels fluctuate during this time interval, observations should be continued until the trend is clearly established. These data should be used to adjust the actual test data to approximate equilibrium conditions.

2. Test Measurements - Rapid changes in the initial static water level occur when the pump test is started. Therefore, readings should be taken as often as possible in as many observation wells as possible. A typical timetable for measurements is:

<b>Time Interval</b>	<b>Measuring Frequency</b>
0 to 2 mn	every 30 seconds
5 to 5 mn	every minute
5 to 10 mn	every 2 minutes
10 to 30 mn	every 5 minutes
30 to 60 mn	every 10 minutes
60 to 120 mn	every 20 minutes
120 to end of test	every hour

This same schedule should be used during the recovery period.

**F. Duration of the Test**

Ideally, the well is pumped at a constant discharge rate until the radius of influence ceases to expand. The minimum pumping time recommended is 1440 minutes, or 24 hours, at a constant discharge rate.

1. Data should be plotted in the field to detect accurately the onset of any recharge boundary conditions.
2. If such effects begin to appear, the duration of the test should be increased until a definite straight line appears on the field plot (Jacob Method).
3. Recovery data should be collected for 24 hours following the test or until water levels have recovered to within 90% of the pretesting level.

**G. Results, Analysis, and Summary**

Data collected shall be analyzed using generally established and accepted methods to determine transmissivity and permeability of the production zone aquifer. The following shall be submitted with the Permit and Production Area Authorization applications:

1. Map locating the monitor and pumped wells, with Production Area acreage indicated;
2. Hydrographs (water level versus time) for the representative number of monitor wells;
3. Piezometric map for each aquifer in the test area;
4. Maximum drawdown map for the test aquifer;
5. Permeability, transmissivity, and storage coefficient at each monitor well

determined;

6. Porosity of selected, representative wells determined from core analysis, electric logs, or other methods.
7. Degree of hydrologic communication between aquifers determined;
8. Hydrologic connection between the Production Zone and its monitor wells verified;
9. Hydrologic boundaries and recharge areas located;
10. Hydraulic gradient for each aquifer determined.

**H. Monitor Well Pump Test**

Where permeabilities do not allow observance of drawdown in a monitor well within 72 hours, as determined by actual test or by calculation, pump tests at the individual monitor wells may be used to supplement information obtained in the full scale pump test. In this instance, analyze the data in the same manner as with the full scale pump test.

**I. Fluid Handling**

Fluids pumped to the surface during hydrologic testing of a production area may not be discharged to the surface but must be pumped to approved holding facilities. This water is normally pumped from the highly mineralized zone and, therefore, represents a pollution potential. The operator should calculate when and what volumes will be pumped to approved fluid holding or disposal facilities during the project.